

## 2. 1975 ENVIRONMENTAL MONITORING RESULTS

The SRP environmental monitoring program is described in detail in Appendix E. Annual reports documenting the analytical data together with descriptive and interpretive material are issued in two series. The 1975 issues of these reports are: *Environmental Monitoring at the Savannah River Plant*,<sup>5</sup> and *Environmental Monitoring in the Vicinity of the Savannah River Plant*.<sup>6</sup> The first report discusses primarily onsite data; the second discusses primarily offsite data. The following paragraphs contain information primarily from the second report; both reports may be consulted for further data and interpretation.

The quantity of radioactivity released by SRP to the environment during 1975 results, for the most part, in concentrations too small to be distinguished from natural background radiation and fallout from worldwide nuclear weapons tests. Particulate beta activity detectable in air is due entirely to global fallout. This concentration in air at the plant perimeter and 25 miles away represents 0.05% of the Concentration Guide (defined in ERDAM 0524).<sup>2</sup> Tritium oxide (HTO) concentrations in air at the plant perimeter are greater than in air at more distant locations; however, the average concentration at the plant perimeter is only 0.04% of the Concentration Guide.

Tritium, <sup>137</sup>Cs, and <sup>90</sup>Sr are the only radionuclides of plant origin detectable in Savannah River water by the routine monitoring program. None of these had an average concentration that exceeded 0.2% of the Concentration Guide in river water sampled 8 miles downstream from the plant. Special research programs using ultra low level techniques have detected trace quantities of other radionuclides of plant origin. Radioactive materials in river fish also continue to be very low.

### ATMOSPHERIC MONITORING

The small amount of particulate beta activity released from SRP to the atmosphere, primarily from the fuel separations areas, is obscured in the area surrounding the plant by worldwide fallout from nuclear tests. The slightly increasing trend (1967 through mid-1972 and again in 1974) is attributed to fallout from atmospheric testing by nonparticipants in the atmospheric testing moratorium. Some increase also normally occurs each spring as a result of the mixing of the stratosphere with the troposphere. Although radionuclides of nonplant origin were found in environmental samples, the average beta concentration in air decreased from  $0.12 \times 10^{-12} \alpha$   $\mu\text{Ci/cc}$  during 1974 to  $0.05 \times 10^{-12}$   $\mu\text{Ci/cc}$

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$\alpha$ .  $10^{-12}$   $\mu\text{Ci} = 0.000000000001 \mu\text{Ci}$  or one-millionth of one-millionth of a microcurie.

during 1975. The 1975 concentrations of particulate beta activity ( $0.05 \times 10^{-12}$   $\mu\text{Ci/cc}$ ) and alpha activity ( $0.0007 \times 10^{-12}$   $\mu\text{Ci/cc}$ ) in air were 0.05% and 3.5% of the respective concentration guides. The average concentrations of  $^{239}\text{Pu}$  in air were  $17.2 \times 10^{-18}$   $\mu\text{Ci/cc}$  at the plant perimeter,  $16.8 \times 10^{-18}$   $\mu\text{Ci/cc}$  at a 25-mile radius, and  $18.6 \times 10^{-18}$   $\mu\text{Ci/cc}$  at a 100-mile radius. The respective  $^{238}\text{Pu}$  concentrations were  $1.3 \times 10^{-18}$   $\mu\text{Ci/cc}$ ,  $1.0 \times 10^{-18}$   $\mu\text{Ci/cc}$ , and  $1.1 \times 10^{-18}$   $\mu\text{Ci/cc}$ . Tritium oxide concentrations in air at the plant perimeter did not exceed 0.1% of the Concentration Guide.  $^{131}\text{I}$  in air samples at plant perimeter and 25-mile-radius stations was less than the level of detection throughout the period (less than 1.5% of the Concentration Guide).

Radionuclides observed from worldwide fallout during the first half of 1975 were  $^{89,90}\text{Sr}$ ,  $^{95}\text{ZrNb}$ ,  $^{106}\text{Ru}$ ,  $^{144}\text{Ce}$ , and  $^{137}\text{Cs}$ . No gamma-emitting fallout radionuclides were identified in air samples or fallout collectors during the last half of 1975. Radioactivity in air is determined from filter analysis. The major component,  $^7\text{Be}$ , is a naturally occurring radionuclide formed by interaction of cosmic rays with oxygen and nitrogen in the upper atmosphere. SRP releases of airborne beta-gamma radioactivity, with the exception of tritium, are not detectable by the routine monitoring program at the plant perimeter, and concentrations are calculated using standard meteorological dispersion equations, normalized to agree with measured dispersion of tritium.<sup>6</sup>

Deposition of beta-gamma worldwide fallout during 1975 averaged  $6.2 \times 10^{-3}$   $\mu\text{Ci/m}^2$  at plant perimeter locations and  $6.5 \times 10^{-3}$   $\mu\text{Ci/m}^2$  at 25-mile-radius locations; comparable values for 1974 were  $6.4 \times 10^{-3}$  and  $11.4 \times 10^{-3}$   $\mu\text{Ci/m}^2$ , respectively.  $^{239}\text{Pu}$  deposition during 1975 was  $2.2 \times 10^{-6}$   $\mu\text{Ci/m}^2$  at the plant perimeter and  $1.9 \times 10^{-6}$   $\mu\text{Ci/m}^2$  at 25-mile-radius locations. Respective  $^{238}\text{Pu}$  depositions were  $0.11 \times 10^{-6}$   $\mu\text{Ci/m}^2$  and  $0.15 \times 10^{-6}$   $\mu\text{Ci/m}^2$ . Rainwater is analyzed weekly for tritium; the average concentration at the plant perimeter in 1975 was  $3.4 \times 10^{-6}$   $\mu\text{Ci/cc}$  as compared with  $1.0 \times 10^{-6}$   $\mu\text{Ci/cc}$  at 25-mile-radius locations.

1975 environmental gamma radiation data are characteristic of measurements observed at individual stations for the past several years ( $\sim 64$  mR/yr). The SRP contribution to gamma radiation is so low as to be indistinguishable from normal variations in natural gamma radiation.

Analyses of undisturbed soil at four locations along the SRP perimeter and two locations at up to 100 miles from the plant were made in 1975 to measure the cumulative deposition of fallout radioactivity from all sources. Concentrations of cesium and plutonium were similar at the plant perimeter and the offsite locations. Concentrations of other gamma-emitting fission products were below the sensitivity of the analyses.

Average concentrations of  $^{137}\text{Cs}$  in the top 15 cm of soil were  $0.45 \times 10^{-6} \mu\text{Ci/g}$  at the plant perimeter and  $0.32 \times 10^{-6} \mu\text{Ci/g}$  at more-distant locations. Average concentrations of total plutonium were  $0.016 \times 10^{-6} \mu\text{Ci/g}$  at the plant perimeter and  $0.009 \times 10^{-6} \mu\text{Ci/g}$  at the distant locations.

## AQUEOUS MONITORING

River water is sampled continuously above and below the plant (the sampling method is described in Appendix E) and is analyzed weekly. Concentrations of alpha and nonvolatile beta emitters in river water for 1975 are summarized in Table III-3. The upstream measurements are attributed to natural radioactivity and worldwide fallout from nuclear weapons tests. The downstream measurements reflect these sources plus releases from SRP.

Tritium and small amounts of  $^{137}\text{Cs}$  and  $^{90}\text{Sr}$  are the only radionuclides of SRP origin detectable by routine monitoring in river water at the downstream location.  $^{90}\text{Sr}$  and tritium from worldwide fallout are also detected in river water upstream from SRP effluents. The sum of the ratios of the average concentrations of all radionuclides found in river water during 1975 to their concentration guides is 0.03, as shown in Reference 6.

Small amounts of other radionuclides are released from SRP operations to plant streams (Table III-1b). However, nuclides other than tritium,  $^{137}\text{Cs}$ , and  $^{90}\text{Sr}$  are not normally detectable in river water because of the very low concentrations resulting from dilution by river water.

TABLE III-3

Radioactivity in Savannah River Water  
 $10^{-9} \mu\text{Ci/cc}^a$

Sampling Point	<u>Alpha Emitters</u>			<u>Nonvolatile Beta Emitters</u>		
	Concentration Guide: 30			Concentration Guide: 3000		
	Sensitivity of Analysis: 0.2			Sensitivity of Analysis: 4.0		
	1975			1975		
	Max	Min	Avg	Max	Min	Avg
1 mile upstream from Upper Three Runs (control)	1.0	ND <sup>b</sup>	ND	6	ND	ND
8 miles downstream from Lower Three Runs at Highway 301	1.5	ND	ND	7	ND	ND

a.  $10^{-9} = 0.000000001$ .

b. ND = Not detectable (less than sensitivity of analysis).

There is no evidence that SRP contributes alpha or nonvolatile beta activity to drinking water supplies of any of the thirteen surrounding towns which do not utilize downstream river water; concentrations of alpha activity ( $0.9 \times 10^{-9}$   $\mu\text{Ci/cc}$ ) and beta activity ( $1.2 \times 10^{-9}$   $\mu\text{Ci/cc}$ ) are almost the same as those observed before plant startup. The higher-than-average alpha activity ( $1.5 \times 10^{-9}$   $\mu\text{Ci/cc}$ ) at Jackson, South Carolina, is naturally occurring radioactivity, primarily  $^{228}\text{Th}$  and its short-lived daughter products. Very low levels of tritium are found in drinking water of several of the towns that use surface water (maximum of  $970 \times 10^{-9}$   $\mu\text{Ci/cc}$ ). Concentrations of tritium in water from deep wells are near or less than the sensitivity of the analyses ( $300 \times 10^{-9}$   $\mu\text{Ci/cc}$ ).

Tritium concentrations in water collected from the Beaufort-Jasper Water Plant averaged  $2100 \times 10^{-9}$   $\mu\text{Ci/cc}$  (0.07% of the Concentration Guide), and those in water from the Port Wentworth Plant averaged  $3300 \times 10^{-9}$   $\mu\text{Ci/cc}$  (0.11% of the Concentration Guide) during 1975. Small  $^{239,240}\text{Pu}$  concentrations measured in a special study using special ultra low level techniques were  $0.99 \times 10^{-12}$   $\mu\text{Ci/cc}$  (0.00002% of the Concentration Guide) and  $2.25 \times 10^{-12}$   $\mu\text{Ci/cc}$  (0.00004% of the Concentration Guide), respectively, at these water treatment plants, compared with  $0.43 \times 10^{-12}$   $\mu\text{Ci/cc}$  (0.000009% of the Concentration Guide) upstream from SRP. These two water plants are the only ones that use Savannah River water for domestic use downstream of SRP.

## VEGETATION AND FOOD MONITORING

### Vegetation

Gamma-emitting radionuclides during the first half of 1975 in grass samples (excluding  $^7\text{Be}$ ) resulted from weapons tests fallout. None was detected during the second half of 1975. Alpha emitters averaged  $0.16 \times 10^{-6}$   $\mu\text{Ci/g}$  at the plant perimeter and  $0.11 \times 10^{-6}$   $\mu\text{Ci/g}$  at the 25-mile-radius locations for 1975, almost the same as during 1974; gamma emitters averaged  $7 \times 10^{-6}$   $\mu\text{Ci/g}$  at the plant perimeter and  $6 \times 10^{-6}$   $\mu\text{Ci/g}$  at the 25-mile-radius locations. Tritium concentration in free water of vegetation was  $14 \times 10^{-6}$   $\mu\text{Ci/ml}$  at the plant perimeter as compared with  $6 \times 10^{-6}$   $\mu\text{Ci/ml}$  at a 25-mile-radius and  $4 \times 10^{-6}$   $\mu\text{Ci/ml}$  at a 100-mile-radius.

### Milk

$^{90}\text{Sr}$  and  $^{137}\text{Cs}$  found in milk in the vicinity of SRP are attributed to worldwide fallout. Average concentrations of these radionuclides in milk samples taken in 1975 were  $10 \times 10^{-9}$   $\mu\text{Ci/cc}$

of  $^{90}\text{Sr}$  and  $11 \times 10^{-9} \mu\text{Ci/cc}$  of  $^{137}\text{Cs}$ .  $^{131}\text{I}$  in milk samples was less than the sensitivity of the analysis ( $1 \times 10^{-9} \mu\text{Ci/cc}$ ) throughout 1975. The strontium, cesium, and iodine values represent 3.3%, 0.05%, and <0.3% of the respective Concentration Guides for water. Tritium in local milk, when present, is assumed to be associated with plant operations. The average tritium level ( $970 \times 10^{-9} \mu\text{Ci/cc}$ ) is 0.03% of the Concentration Guide for water.

### Farm Produce

SRP contributions to the levels of radioactivity (excluding tritium) in farm produce were so low in 1975 that they were indistinguishable from fallout. All radionuclides in food are near or below the levels of detection. Results for  $^{90}\text{Sr}$  are about the same as in the 1974 samples with the highest concentration in collards ( $2.9 \times 10^{-6} \mu\text{Ci/g}$ ). Tritium concentrations in foods are similar to those found in rainwater, with a maximum value ( $6 \times 10^{-6} \mu\text{Ci/cc}$ ) in samples collected near the plant perimeter.

### Fish

The radioactivity in bone and flesh of fish shows only minor contribution by SRP, and concentrations are of minor significance from a radiation dose standpoint. An adult regularly consuming fish from the river adjacent to SRP (at a rate of 25 lb/yr) would receive a whole body dose of only 0.18 mrem as compared to approximately 120 mrem from natural radiation.

### Deer

$^{137}\text{Cs}$  concentrations in deer killed on the SRP site are well within the range of concentrations found in deer killed in similar terrain through the southeast. The cesium originated almost entirely from that deposited by fallout from nuclear weapons tests. The average  $^{137}\text{Cs}$  concentration in deer killed in controlled hunts at SRP and analyzed during 1975 was  $9 \times 10^{-6} \mu\text{Ci/g}$  with a maximum of  $36 \times 10^{-6} \mu\text{Ci/g}$ . Edible meat from the deer containing  $36 \times 10^{-6} \mu\text{Ci/g}$  would weigh about 66 lb and would therefore contain about 1.08  $\mu\text{Ci}$  of  $^{137}\text{Cs}$ . An adult eating all of this deer meat would receive a whole body dose of 65 mrem to the whole body, 54% of the annual dose South Carolina residents receive from natural radiation. Other than naturally occurring  $^{40}\text{K}$ , no other gamma-emitting radionuclide was detected in the muscle tissue. Cesium analysis data for deer killed in all SRP hunts (beginning 1965) are summarized in Table III-4.

TABLE III-4

 $^{137}\text{Cs}$  in Deer, pCi/g<sup>a</sup>

Year	<i>No. of Deer Killed</i>		<i>Average</i>		<i>Maximum</i>	
	<i>SRP</i>	<i>SCCP<sup>b</sup></i>	<i>SRP</i>	<i>SCCP<sup>b</sup></i>	<i>SRP</i>	<i>SCCP<sup>b</sup></i>
1965	198 <sup>c</sup>		<10		10	
1966	541 <sup>c</sup>		6		24	
1967	1032 <sup>c</sup>		9		104 <sup>d</sup>	
1968	699 <sup>c</sup>	34	12	23	74 <sup>e</sup>	80
1969	889 <sup>c</sup>	31	16	15	204 <sup>e</sup>	72
1970	863	33	12	20	77 <sup>e</sup>	72
1971	865	42	11	21	48	42
1972	808	72	8	11	38	32
1973	1162	78	6	16	38	49
1974	1553	89	5	9	52	23
1975	1390	35	9	18 <sup>f</sup>	32	34 <sup>f</sup>

a. 1 pCi/g =  $10^{-6}$   $\mu\text{Ci/g}$ .

b. SCCP - South Carolina Coastal Plains.

c. Approximately 20% of deer monitored; each deer monitored since 1969.

d. Killed along Four Mile Creek, below H Area.

e. Killed near Steel Creek.

f. Analysis incomplete.